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**GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS  
IN WESTERN COLORADO, USING SKYLAB EREP DATA**

**Monthly Progress Report**

**January - February 1975**

**EREP Investigation 380  
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## INTRODUCTION

The primary objective of the CSM Skylab Program is to analyze EREP data for geologic information. To this end, the research has been subdivided into the following tasks;

- Task I. The PI shall assist NASA/MSC in mission planning activities related to the proposed investigation.
- Task II. The investigator will screen all EREP data obtained over Colorado and will select frames for detailed study.
- Task III. The investigator will prepare photogeologic maps using selected S-190 photographs, and will analyze them to determine what geologic information may be contained in them.
- Task IV. The geological interpretations obtained in Task 3 will be compared to interpretations obtained from S-192 imagery, and to interpretations made from ERTS-I imagery.
- Task V. The geological interpretations will be verified by means of interpretation of aerial photographs, published geological reports, and field observations.
- Task VI. The investigator will prepare recommendations for the optimum type, scale, and resolution of imagery to be used for studies of regional geology and exploration for mineral deposits and water resources.

## Progress

### Overall Status

The progress of the research is as anticipated.

### Past Month's Activity

The technical paper "Shadow Enhancement of Linears in Images" was completed in January and submitted to Photogrammetric Engineering and Remote Sensing. A copy of this manuscript was submitted to NASA previously.

Abstracts for three technical papers were written, two of which were directly supported by Skylab research. These will be submitted to NASA for consideration for presentation at the Earth Resources Survey Symposium in June.

Photointerpretation of Skylab S190B color photos of SW Colorado-SE Utah continued. Based on the results of the photointerpretation at a scale of 1:250,000, an attempt was made to use enlargements of 8X, or about 1:125,000, for geologic annotation. The annotated photography was then transferred to base topo maps at 1:62,500. Preliminary results are most encouraging; all stratigraphic units at formation rank were mapped, and in some cases units at member rank could be recognized and, in part, mapped. It appears now that in two instances, lateral facies changes or stratigraphic pinchouts were recognized, but this remains to be verified.

S192 multispectral scanner imagery from SL3, track 16, taken 15 September 1973, over an area from Monticello, Utah, to Montrose, Colorado, was evaluated. Imagery was unfiltered, uncorrected black/white 5-inch wide transparencies. Some observations include:

- (a) Contacts and lithologic units were most visible on channels 11, 17, and 20. Contrast is greatest on channels 11, 17, and 19, and scan lines are least visible on channel 11,

- (b) Most detail in dark (vegetation-covered) areas is on channels 7, 11, 13, 17, 19, and 20,
- (c) Cultivated fields (and their geometric shapes) are most consistently visible on channels 1 and 3,
- (d) Rivers are most consistently visible on channel 11, and
- (e) Clouds are easily seen on all channels (black on channel 21).

A preliminary ranking of channels by quality (best contrast, least distortion, least scan lines) shows channel 11 "best" and channel 22 "worst":

<u>Rank</u>	<u>Channel</u>	<u>Band</u>	<u>Wavelength (micrometers)</u>
1	11	11	1.55-1.75
2	17	10	1.2-1.3
3	20	9	1.09-1.19
4	19	8	0.98-1.08
5	13	12	2.1-2.35
6	7	6	0.68-0.76
7	3	4	0.56-0.61
8	1	3	0.52-0.56
9	9	7	0.78-0.88
10	5	5	0.62-0.67
11	18	2	0.42-0.51
12	21	13-1	10.2-12.5
13	22	1	0.41-0.46

Skylab coverage of the area of the compiled geologic map of the Bonanza test site was evaluated. Coverage is available as follows at up to 4X enlargement.

Date	Mission	Sensor	Track	Frame	Clouds
6/73	SL2	S190A	48	17-20	10% localized
8/73	SL3	S190A	48	116-120	20% localized
2/74	SL4	S190A	48	38-39	80% localized

No S190B or S192 coverage is available.

An attempt was made to fill in incomplete coverage on the map centered on the Wet Mountain Valley. Three major lithologic units were detectable: Precambrian metamorphic rocks, Tertiary volcanics, and alluvium of the Sangre de Cristo Mountains piedmont. Internal details are available only in portions of the metamorphic terrain where some folds are outlined. Some major new linears were mapped. The major fault along the west side of the Wet Mountains was filled in and extended to the north and south where not previously mapped.

Minor photointerpretation of Skylab photos of northwestern Colorado was continued in an area where ERTS imagery was studied previously. Individual beds of the Mesaverde Fm. can be seen that were not visible on the ERTS imagery. Structure, where visible, is more easily recognized on Skylab photos. No thorough, systematic comparison of the two types of images will be possible because of extensive cloud cover.

The detectabilities of lithologic contacts were evaluated on available S190-A photography of two geologically-contrasting terrains in Colorado: (1) the Canon City area of south-central Colorado, where two investigators independently evaluated the detectabilities of twelve contacts and (2) the Paradox region of southwestern Colorado where ten contacts were evaluated by a single investigator. Detectabilities were determined by evaluating the ease of detecting specific contacts on high-altitude color photography (detectability of 1.0) as compared to S190-A photos. The detectability data will be statistically analyzed to determine trends and variations in contact image expression. Attempts will be made to explain these trends and variations in terms of imaging and surface parameters. To date, only some relatively simple statistical properties of the data sets have been determined; from these properties the following preliminary interpretations have been made:

- 1) black and white IR photos are not useful for contact detection
- 2) SL90-A color photos have the best overall contact detectabilities
- 3) black and white, red- and green-band photos have about the same mean detectability values; these values are greater than for color IR photos, but less than for color photos
- 4) wintertime (SL4) photos have the highest mean detectabilities in the Canon City area, but the lowest in the Paradox region. The low detectabilities in the Paradox region may be caused by snow that covered the area during SL4
- 5) detectability evaluations by different investigators in the same area were found to differ consistently in absolute value, but the relative detectabilities (normalized data) were remarkably consistent.

During the next reporting period, additional statistical tests will be performed on the detectability data, with the goal of isolating imaging and surface parameters that significantly affect the image expression of lithologic contacts on Skylab photos.

#### Planned Activities for Current Month

Research in March will continue on those projects outlined above.

#### Travel

Travel in January-February consisted of one trip by the Principal Investigator to Lawrence, Kansas, to attend a geologic remote sensing conference. No travel is anticipated in March, although some field work may begin soon as weather and snow cover permit.

Outlook and Recommendation

Progress continues to be satisfactory, and the project could be completed on schedule. I believe the results of the research, however, would be more meaningful if more time were devoted at this stage to field checking of interpretations. For this reason, it is my intention to request additional time and funding to run the project through the 1975 field season, until October 1975.

 Daniel H. Keenan

Keenan Lee  
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